Chapter 4

Kingdom Protista

- **Protista** is a kingdom of **unicellular eukaryotes** (except red and green algae).
- The kingdom was created by **Haeckel in 1886**.
- Protists include solitary unicellular or colonial unicellular eukaryotic organisms **which do not form tissue**.
- They are mostly aquatic.
- The unicells may be naked or covered by cell wall, pellicle, shell or cuticle.
- A well defined nucleus is present. Protists can be uninucleate, binucleate or multinucleate.
- The genetic material is **linear DNA**, **enclosed by nuclear envelope**, **complexed with proteins** and **organised into distinct chromosomes**. This character continues in the remaining three kingdoms.
- The cytoplasm contains besides ribosomes, a variety of organelles such as mitochondria, plastids (in photosynthetic protists), lysosomes, cytoskeleton, endoplasmic reticulum and Golgi bodies. Ribosomes are of two types, 80 S cytoribosomes and 70 S organelle ribosomes. Many have centrioles also.
- Cytoplasm is always in motion. The phenomenon is called **cytoplasmic streaming** or **cyclosis**.
- Cell wall, if present, contains cellulose.
- Food reserve is **starch**, **glycogen**, **paramylon**, **chrysolaminarin and fat**.
- All the three types of life styles (plant, animal and fungal) occur in protists.
- **Some protistans are parasitic**. Some **live symbiotically** as in the gut of animals while a few **act as decomposers**.
- Protistans are **connecting link between monerans and rest of the kingdoms**.
- **Asexual reproduction** is quite common and **occurs through budding**, **binary fission**, **multiple fission**, **plasmotomy**, **sporulation**, **cyst formation**, etc.
- **Sexual reproduction** occur with the help of nonjacketed gametangia. It **involves meiosis and karyogamy**.
- Mitotic apparatus is formed during cell division.
- No embryo is formed.
- In many forms, plastids, (9 + 2 strand) flagella and other organelles are present.
- The nutritive modes of these organisms include photosynthesis, absorption, ingestion and combination of these.
- The organisms **move by flagella**, **cilia**, **pseudopodia**, **contraction** and **mucilage extrusion**.
- **Kingdom protista (also called protoctista) is divided into 3 main groups** –
  - **Photosynthetic protists** (Protistan algae) – Eg., **dinoflagellates** or class dinophyceae (certain, *Glenodinium, Gymnodinium, Gonyaulax, Noctiluca* and *Peridinium*); **diatoms** or class bacillariophyceae (*Navicula, Nitzchia, Metosira, Cymbella, Amphipleura, Pinnularia*) and **euglenoids** or *Euglena* like flagellates (*Euglena, Eutreptia, Phacus, Peranema*).
  - **Consumer protists –** Slime moulds or Myxomycetes, eg., *Physarum, Physarella.*
  - **Protozoan protists –** Eg., *Giardia, Trypanosoma, Leishmania, Amoeba, Entamoeba, Plasmodium* (malarial parasite), *Paramecium* etc.

Important groups of protista

Chrysophytes [Diatoms and Golden Algae (Desmids)]

- **Diatoms** included in phylum chrysophyta of algae are also known by the name **golden algae**.
- They have been grouped under two categories, namely pennate types and centric types.

- **Pennate types** are **bilaterally symmetrical and centric types** are **radially symmetrical**.
- Diatoms have cell walls containing **silica**, **constructed in two overlapping halves**, which fit together like two parts of a soap box (pennate types) or pair of petridishes (centric types).
- The **outer wall is called epitheca** and **inner wall is a called hypotheca**.
- They are present in both fresh and salt water and comprise an important food for the aquatic animals. However, out of 5,500 species mostly are marine.
- They **lack flagella** and **float mainly due to light storage lipids** present in them.
- Due to their silica impregnations, the walls of diatoms are indestructible.
- As a result diatomaceous earth formation has occurred due to remains of cell walls of diatoms in the form of fossils.
- Silica wall of diatoms is designed with fine ridges, lines, pores etc.
- These ornamentations are either radially symmetrical or bilaterally symmetrical on either side of the long axis of the cell.
- **Food reserve** is **oil** and **chrysolaminarin** or **leucosin** (β 1 - 3 glucan)
- Multiplication is through **binary fission**.
- Binary fission reduces the size of most daughters due to relation of one valve of the parents. This is corrected through the development of **rejuvenescent cells or auxospores**. Eg - *Coscinodiscus*, *Stephanodiscus*, *Cymbella* etc.
- Diatoms may **exhibit slow gliding movements** produced by streaming of cytoplasm through grooves on the surface of cell wall.
- Due to various designs over the cell wall, they have been **regarded as jewels of the plant kingdom**.
- The oils extracted from some fishes and whales are actually the ones produced by diatoms.
- Diatomite deposits are often accompanied by petroleum fields. Much of the petroleum of today is probably due to decayed bodies of the past diatoms.
- Diatomite is porous and chemically inert. It is therefore, used in filtration of sugars, alcohols and antibiotics.
- Diatomite is employed as a cleaning agent in tooth pastes and metal polishes.
- Diatomite is added to paints for enhancing night visibility.
- Diatomite is employed as insulation material in refrigeraters, boilers and furnaces.
- Diatomaceous earth is added to make sound proof rooms. It is a good industrial catalyst and a source of water glass or sodium silicate.
- Diatomite was at one time employed in handling and storage of dynamite and strong acids.

Dinoflagellates

- They comprise the phylum pyrrophyta of algae, golden brown photosynthetic protists.
- They are single celled, most of them are surrounded by a shell made up of thick interlocking plates covered with cellulose cell wall.
- They are **motile with two flagella** (hence dinoflagellates) one projecting from one end and the other running in a transverse groove.
- Like diatoms they **have fucoxanthin** in addition to chlorophyll.
- They are **autotrophic and photosynthetic** (e.g. *Ceratium*). *Blastodium* is a colourless parasite on animals.
- The **food reserves** is in **the form of oils** and **polysaccharides**.
- Most of the dinoflagellates are marine and important photosynthesizer in the ocean.
- Occasionally members like *Gonyaulax* accumulate in large numbers in some parts of sea, colouring the water red and are responsible for red tide.
- *Gonyaulax* **causes** '**red tides**' because **it shows bioluminescence or phosphorescence** and make the sea look red.
- Some species of dinoflagellates are poisonous to vertebrates and when these accumulate, large number of fish in that region of ocean may be killed.
- A non-contractile vacuole or pusule is present.
- Due to presence of two flagella at right angles to each other, the dinoflagellates show peculiar spinning movement. Hence, they are called **whorling whips**.
- Nucleus is **mesokaryon** with condensed chromosomes even in interphase. Histone is absent. Division occurs through **dinomitosis** in which the **nuclear envelope persists**.
- Microtubular spindle is not formed. **Chromosomes are acentric** and move while attached to inner membrane of nuclear envelope.
- Dinoflagellates may have eye spots, **trichocyst** (*e.g.*, *Peridinium*) and **cnidoblasts** (*e.g.*, *Nematodinium*).

- Some forms show **bioluminescence** or phosphorescence, and are called **fire algae** *e.g.*, *Noctiluca*, *Gonyaulax*.
- Method of reproduction is **only asexual**. **Sexual reproduction is usually absent** (exception– *Ceratium*).
- Some species of dinoflagellates are taken as food by mussels. These mussels remain unharmed by dinoflagellates but if man eats these infected mussels, he may fall ill.

Euglenoids

- Euglenophyceae includes flagellate protists of fresh water and damp soils.
- Presence of anterior invagination like some ciliates has given the name plant-animals.
- **Euglenoids are more advanced than blue-green algae from evolutionary point of view, for they have a definite easily stained nucleus and the chlorophyll is not scattered in granules but is localized in chloroplasts as in higher plants. The nuclear envelope persists during division**.
- They are free living, found in fresh water ponds and ditches or in the damp soil.
- Euglenoids are **characterised by absence of cell wall**, but they do **contain flexible pellicle made up of protein**.
- All the euglenoids **have one or two flagella** (tinsel and tactellum) by means of which they can swim easily.
- *Euglena* is more readily available protist for laboratory studies.
- *Euglena* bears a flagellum inserted at the anterior end in a cavity.
- They **bear a red pigmented eye spot** and a gullet near the base of the flagellum. The pigment in eye spot is **astaxanthin**.
- A swelling called **paraflagellar body** is found in the region of union of flagellar roots.
- Photosynthetic forms bears many, radiating chloroplasts of various shapes.
- The chloroplasts contain pigments like **chlorophyll a**, **chlorophyll b**, **xanthophyll**.
- Nucleus with one or more prominent nucleoli occurs.
- Pyrenoids may or may not be present.
- Some euglenoids are green and **holophytic** (photo autotrophic) like other plants. Few are non-green and **saprobic** like fungi and bacteria.
- Some capture and ingest the organisms like animals (holotrophic). Green forms have saprobic mode pickup organic matter from outside (myxotrophic).
- Holotrophic or phagotrophic nutrition is absent in *Euglena*.
- Euglenoids **store carbohydrates** in the form of **paramylum chemically**, **distinct from starch and glycogen**.
- Reproduction is usually **asexual by cell division** but sexual reproduction has been reported in one genus.
- Under favourable condition, euglenoids reproduce by simple, **longitudinal binary fission**.
- Flagellum disappears prior to division.
- Most of the species produce **cyst** having thick stratified membranes with **deep red colouration due to synthesis of haematochrome**.
- Besides cyst formation, many of non-flagellate cells may get embedded in a common gelatinous sheath resembling a **palmella stage** (as in algae).
- Eg – *Euglena, Paranema, Trachelomonas*.

Slime moulds

- Slime moulds are **consumer decomposer protists**.
- Asexual reproduction takes place through **binary fission**, **plasmotomy**, **spores**, **cyst** and **sclerotium**.
- Sexual reproduction is **isogamous or anisogamous**.
- Both zygotic meiosis (cellular slime moulds) and gametic meiosis (acellular slime moulds) occur.
- Slime moulds have **characters of plants** (cellulose cell wall), **animals** (phagotrophic nutrition), and **fungi** (spores). They **take part in both decomposition of organic matter** and **feeding of other decomposer organisms**.
- Slime moulds, therefore, **live in contact with organic matter**.
- Slime moulds (500 sp.) **have several features** which are **animal like in their vegetative stages** and **plant like in reproductive stages**.
- The slime moulds are widely distributed, growing in damp and shady places.
- They may be found in the soil rich in humus, damp old planks of wood, rotting logs, decaying leaves etc.
- They **prefer moisture and darkness or dim-light for normal growth**, they move to drier and exposed habitats during reproductive phase.
- More than 100 species, have been reported from India.
- The **vegetative phase** of the thallus is a **free-living**,

naked, **multinucleated mass of protoplasm called plasmodium**.

- The plasmodium consists of **diploid nuclei**, **lacks cell wall** and **secretes lime**.
- The plasmodium shows amoeboid movement **by producing pseudopodia**.
- Chlorophyll is lacking, so these are generally saprophytic, rarely parasitic causing abnormal swellings upon the bodies of hosts.
- They reproduce by means of spores produced in sporangia.
- The spores have cellulosic cell wall and are produced through meiosis.
- The slime moulds are generally holocarpic.
- The spores germinate to produce myxamoebae or biflagellated swarm cells behaving as gametes.
- The swarm cells fuse in pairs showing isogamous types of sexual reproduction.
- Slime moulds may be colourless or variously coloured like yellow, orange, brown etc.
- Slime mould are of **two types** – **acellular** and **cellular**.
- **Acellular slime moulds** have a wall-less multinucleate protoplasm or **plasmodium** without (**protoplasmodium**) or with a number of branched veins showing cyclosis (Phaneroplasmodium).
- Multiplication occurs by plasmotomy.
- Normally when food is about to exhaust, the plasmodium comes to rest and develops sporangium.
- Each sporangium has a noncellulosic covering called **capillitium**. Eg, *Fuligo*, *Physarum*.
- **Cellular slime moulds** are initially in the form of haploid uninucleate wall-less **myxamoebae** which are surrounded by mucilage, move about by pseudopodia and feed on bacteria and other micro-organisms through ingestion.
- Myxamoebae multiply by **binary fission**.
- Sexual reproduction occurs occasionally through **macrocyst formation**. Eg. *Dictyostelium*, *Polysphondylium*.

Protozoa

- Protozoa (also included in the animal kingdom) are unicellular organisms having varied form, structure, and holozoic, saprobic or parasitic nutrition. Reserve food is glycogen, cysts occurs during unfavourable condition. Asexual reproduction by fission or budding and sexual reproduction by conjugation or syngamy.
- Major groups of protozoans based on locomotary organs are –
  - **Zooflagellata** (Flagellated protozoans)
  - **Sarcodina** (Amoeboid protozoans)
  - **Ciliata** (Ciliated protozoans)
  - **Sporozoa**

  [*For more details refer chapter Protozoa*]

End of the Chapter